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Revision of the genus *Woldstedtius* Carlson, 1979 (Hymenoptera, Ichneumonidae, Diplazontinae) from Japan

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Abstract

Japanese species of the genus *Woldstedtius* Carlson, 1979 are revised. Nine species are recorded from Japan, including two new species, *W. alpicola* **sp. nov.** and *W. punctatus* **sp. nov.** *Woldstedtius biguttatus* (Gravenhorst, 1829) is newly recorded from Japan. Taxonomic status of *W. flavolineatus kuroashii* (Uchida, 1957) is changed from the subspecies of *W. flavolineatus* (Gravenhorst, 1829) to a separated species. *Woldstedtius holarcticus* (Diller, 1969) is newly synonymized under *W. kuroashii* (Uchida, 1957). A key to Japanese species of this genus is provided.

Key Words

Asia, fauna, new species, parasitoid wasps, taxonomy

Introduction

The Ichneumonid subfamily Diplazontinae comprises 23 genera and more than 350 species worldwide (Yu et al. 2016). The host range of species in this subfamily appears to be notably narrow, with all confirmed hosts being species of hoverfly (Diptera, Syrphidae). The only exceptions in this regard are two species in the ichneumonid genus *Bioblapsis* Förster (Klopfstein 2014). The genus *Woldstedtius* Carlson, 1979 is a relatively large taxon comprising 44 species distributed in the Australasian, Holarctic, Neotropical, Oceanic, and Oriental regions (Balueva and Lee 2016; Vas 2016; Yu et al. 2016; Johansson 2020). Although the genus has been revised by Klopfstein (2014) for the Western Palearctic species, by Dasch (1964) for the Nearctic species and by Gauld et al. (1997) for the Costa Rican species, members in the Eastern Palearctic region have only been partially studied. Manukyan (2007), for example, provided a key to the six species of this genus known from Far East Russia, and Balueva and Lee (2016) have reviewed the South Korean species. In Japan, seven species have been formally recorded to date (Yu et al. 2016), however, we have found specimens of some unidentified species and identified a number of unresolved taxonomic problems. Nevertheless, given the large number of previous studies in other regions, this genus may be an adequate taxon for comparison of the fauna with that in other parts of the world.

The purpose of this study was to undertake a taxonomic review of the Japanese species of *Woldstedtius*. We have also produced a key to the Japanese species of this genus, which is presented herein.

Materials and methods

In this study, the dried specimens deposited in the following collections were examined:

AEIC American Entomological Institute, Logan, Utah, USA;

KPMNH Kanagawa Prefectural Museum of Natural History, Odawara, Kanagawa, Japan;

MU Meijo University, Nagoya, Aichi, Japan;

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NSMT National Museum of Nature and Science, Tsukuba, Ibaraki, Japan;
SEHU Systematic Entomology, Hokkaido University, Sapporo, Japan;
TMNH Toyohashi Museum of Natural History, Toyohashi, Aichi, Japan;
ZSM Zoologische Staatssammlung München, Germany.

Stereomicroscopes (SMZ745 and SMZ800: Nikon, Tokyo) were used for observation. Photographs (Figs 1, 2, 4–7) were taken by digital camera (TG-4: Olympus, Tokyo) attached to the stereomicroscope (SMZ800). Photographs (Figs 3, 8) were taken by digital camera (CX6: RICOH, Tokyo) attached to the stereomicroscope (SMZ745). Digital images (Figs 1–9) were edited using Adobe Photoshop.

Morphological terminology mainly follows those established by Broad et al. (2018). The following abbreviations are used in description, diagnosis, and remarks: ocello-ocular line (**OOL**), postocellar line (**POL**), diameter of lateral ocellus (**OD**), segments of flagellomeres (**FL**), segments of maxillary palp (**MP**), metasomal tergites (**T**) and holotype (**HT**). The following abbreviations are used in material data: female (**F**), male (**M**), flight interception trap (**FIT**), light trap (**LT**), Malaise trap (**MT**) and yellow pan trap (**YPT**).

Results and discussion

Woldstedtius flavolineatus kuroashii (Uchida 1957) was originally described based on a single female, for which no morphological information, apart from the coloration of mesosoma and legs, is available. Therefore, we examined Japanese specimens of *W. f. kuroashii*, including the holotype, and compared these with the identified European specimens of *W. f. flavolineatus* deposited in ZSM (identified by Diller). On the basis of these comparison, we established that certain character states of *W. f. kuroashii* are clearly different from those of *W. f. flavolineatus*, and accordingly conclude that this subspecies should be treated as a separate species, *W. kuroashii*.

Woldstedtius holarcticus Diller, 1969 resembles *W. kuroashii* in terms of color and body structures. In Japan, Manukyan (2007) recorded this species from Kunashiri Island, although no additional specimens of the species have been recorded elsewhere in Japan. We compared the Japanese specimens of *W. kuroashii*, including holotype, with a paratype of *W. holarcticus* deposited in ZSM. As we detected no clear differences between the two taxa, we propose that *W. holarcticus* should be synonymized under the name *W. kuroashii*. Diller (1969) noted that females of *W. holarcticus* (= *W. kuroashii*) can be distinguished from those of *W. flavolineatus* with respect to coloration of the coxae, the proportions of the hind tibia and tarsus, and surface gloss of the body, and also established that the females of *W. holarcticus* (= *W. kuroashii*) can be distinguished from those of *W. f. flavolineatus* based on the medially flattened face (medially convex in *W. f. flavolineatus*). We confirmed this character state and established that the face is slightly convex medially in both *W. kuroashii* and *W. f. flavolineatus*, although this feature is weaker in the former than in the latter (Fig. 9A, B). However, given the overlap in the intraspecific variation of this character state, it cannot be reliably used to differentiate the two species. The leg coloration (with the exception of the coxae) of *W. kuroashii* collected from Honshu (including the holotype) is darker compared with that of some Japanese specimens collected from Hokkaido and female paratypes of *W. holarcticus* (blackish-brown to black) (orange to brown in some Japanese specimens collected from Hokkaido and the paratype of *W. holarcticus*). As a consequence of these comparisons, we detected no significant differences with respect to other character states of these specimens, and accordingly conclude that the observed variation is intraspecific variation within a single species.

In this study, we identified specimens of *W. biguttatus* from Japan for the first time. This species closely resembles *W. flavolineatus*, and indeed, some *W. biguttatus* specimens have been incorrectly recorded as *W. flavolineatus* e.g., Konishi et al. (2014) and Morishita et al. (2021). In contrast, we were unable to find any specimens of *W. flavolineatus* that have been collected in Japan. Given that some of the voucher specimens of the previous studies could not be reliably identified owing to inadequate labeling, we have certain reservations as to the Japanese distribution records of *W. flavolineatus*, and accordingly recommend a further re-examination of the distribution of this species.

On the basis of the aforementioned taxonomic treatments, we conclude that a total of nine species in the genus *Woldstedtius* have been found in Japan to date.

Taxonomy

Subfamily Diplazontinae Viereck, 1918

Genus *Woldstedtius* Carlson, 1979

Type. *Bassus biguttatus* Gravenhorst, 1829: 332. Original designation.

Diagnosis. According to Klopfstein (2014), this genus can be distinguished from other genera by the following combination of character states: antenna without tyloids in males; mesoscutum without notauli; fore wing areolet absent; hind tibia usually black with a white base, in males with light coloration often extending to half the length of the tibia, rarely hind tibia all dark or yellow or orange with a dark apex; ovipositor sheaths transversely truncate and open towards apex; very even, weakly coriaceous microsculpture.

Remarks. Japanese species can be identified by the following key.

Key to Japanese species of *Woldstedtius* (males of *W. takagii* and *W. yokohamensis* are unknown)

1 Hind coxa white with a brown dorsal stripe in females (Fig. 4A). Face blackish-brown to black with a white median spot, this spot connected with white clypeus in females (Fig. 4B), entirely white in males (Fig. 4F). Scutellum with large white marking (Fig. 4C). Latero-median carina of T I short, along less than basal 0.3 of T I (Fig. 9H) ..... *W. karafutensis* (Uchida, 1957) (female and male)

– Above combination of character states lacking. Hind coxa entirely black or entirely orange in females (Figs 1A, 2A, 3A, 5A, 6A, 7A, 8A). Coloration of face various in females. Scutellum entirely black or black with a whitish-yellow to yellow apical spot (Figs 1C, 2C, 3C, 5C, 6C, 7C, 8C). Latero-median carina of T I long, along more than basal 0.4 of T I (Fig. 9E–G, I–K) 2

2 Hind coxa entirely black in both sexes (Figs 1A, 5A, 6A, E, 7A, 8A) 3

– Hind coxa entirely orange in females (Figs 2A, 3A), entirely or largely yellow to reddish-yellow and usually with a blackish-brown dorsal stripe in males (Figs 1E, 2E, 3 E, 5E) 7

3 Inner orbits divergent downward (Figs 7B, 9C). Face 2.6–2.9 × as broad as high. Basal 0.2 of propodeum weakly protruded in lateral view (Fig. 9D). Yellow shoulder marks of mesoscutum absent (Fig. 7A) ..... *W. takagii* (Uchida, 1957) (female)

– Inner orbits almost parallel (Figs 1B, 5B, 6B, 8B). Face less than 2.5 × as broad as high. Basal 0.2 of propodeum not protruded in lateral view. Yellow shoulder marks of mesoscutum present (Figs 1A, 5A, 6A, 8A) 4

4 Scutellum coarsely and densely punctate (separated by ca. 0.8–1.3 × their diameter) and entirely black (Fig. 6C). Propodeum rugulose (Fig. 6D) ..... *W. punctatus* sp. nov. (female and male)

– Scutellum finely and sparsely punctate (separated by ca. 1.5–2.5 × their diameter) and black with a whitish-yellow to yellow apical spot (Figs 1C, 5C, 8C). Propodeum coriaceous or at least finely rugulose 5

5 Face black with a pair of yellow spots along inner orbits (Fig. 8B). Scutellum finely and densely punctate (separated by ca. 1.0 × their diameter) ..... *W. yokohamensis* (Uchida, 1957) (female)

– Face black with a whitish-yellow to yellow median spot (Figs 1B, 5B). Scutellum finely and sparsely punctate (separated by ca. 1.5–2.5 × their diameter) (Figs 1C, 5C) 6

6 T I 1.4–1.5 × as long as maximum width. Propodeum finely rugulose (Fig. 1D). Hind trochanter black (Fig. 1A). Pleural carina of propodeum entirely present ..... *W. alpicola* sp. nov. (female)

– T I 1.1–1.25 × as long as maximum width. Propodeum coriaceous (Fig. 5D). Hind trochanter white (Fig. 5A). Pleural carina of propodeum absent posteriorly ..... *W. kuroashii* (Uchida, 1957) (female)

7 Inner orbits divergent downward. Antenna with 19–21 (rarely 22) flagellomeres. Metasoma entirely black or black with some orange markings in females ..... *W. citropectoralis* (Schmiedeknecht, 1926) (female and male)

– Inner orbits almost parallel in females (Figs 2B, 3B), weakly divergent downward in males (Figs 1F, 2F, 3F, 5F). Antenna with 22–25 flagellomeres. Metasoma entirely black in females 8

8 Mesoscutum without yellow shoulder marks in females (Fig. 2A). Face entirely black or black with a small median yellow or brown spot in females (Fig. 2B). Mesopleuron with a yellow ventral marking (Fig. 2E) in males. Mesosternum black in males (Fig. 2E) ..... *W. biguttatus* (Gravenhorst, 1829) (female and male)

– Mesoscutum with yellow shoulder marks in females (Fig. 3A). Face black with a large yellow median spot in females (Fig. 3B). Mesopleuron with a large whitish-yellow to yellow marking; it is enlarged anteriorly in males (Figs 1E, 3E, 5E). Mesosternum yellow in males (Figs 1E, 3E, 5E) 9

9 Propodeum finely rugulose (e.g., Fig. 1D), with a complete pleural carina. Bases of T IV to T VII each with a transverse yellow band ..... *W. alpicola* sp. nov. (male)

– Propodeum coriaceous (e.g., Figs 3D, 5D), with a pleural carina absent posteriorly in both sexes. Coloration of T IV to T VII various in males 10

10 Bases of T III and T IV each with a transverse yellow basal band in males. T I entirely coriaceous ..... *W. flavolineatus* flavolineatus (Gravenhorst, 1829) (female and male)

– T III with a pair of whitish-yellow apical spots (sometimes these spots connected each other). T IV and T V each with a transverse whitish-yellow apical band. T I coriaceous, with irregular rugae laterally..... *W. kuroashii* (Uchida, 1957) (male)

Woldstedtius alpicola sp. nov.

http://zoobank.org/E030CAC0-73B1-4BDC-BD63-F5E6BD3BAC4B

Figs 1A–F, 9E

Type series. ***Holotype*:** F, Japan, Honshu, Mie Pref., Inabe City, Mt. Fujiwaradake, 1 Jun 2021, S. Morishita leg. (KPMNH). ***Paratypes*:** Japan: [Honshu] 1 F, Yamanashi Pref., Koshu City, Mt. Daibosatsu, Kaminikkawa-toge, 16 Jun 2007, K. Watanabe leg. (TMNH); 1 M, Kanagawa Pref., Yamakita Town, Mt. Oomuroyama–Mt. Kanyuudousan, 15 Jun 2008, H. Kawai leg. (KPMNH); 1 F, Nagano Pref., Otaki Vil., Mt. Ontakesan, 13–25 Jul 2015, S. Shimizu leg. (MT) (KPMNH).

Description. Female (n = 3). Body length 8.5–9.2 (HT: 8.5) mm, polished, coriaceous and covered with silver setae.

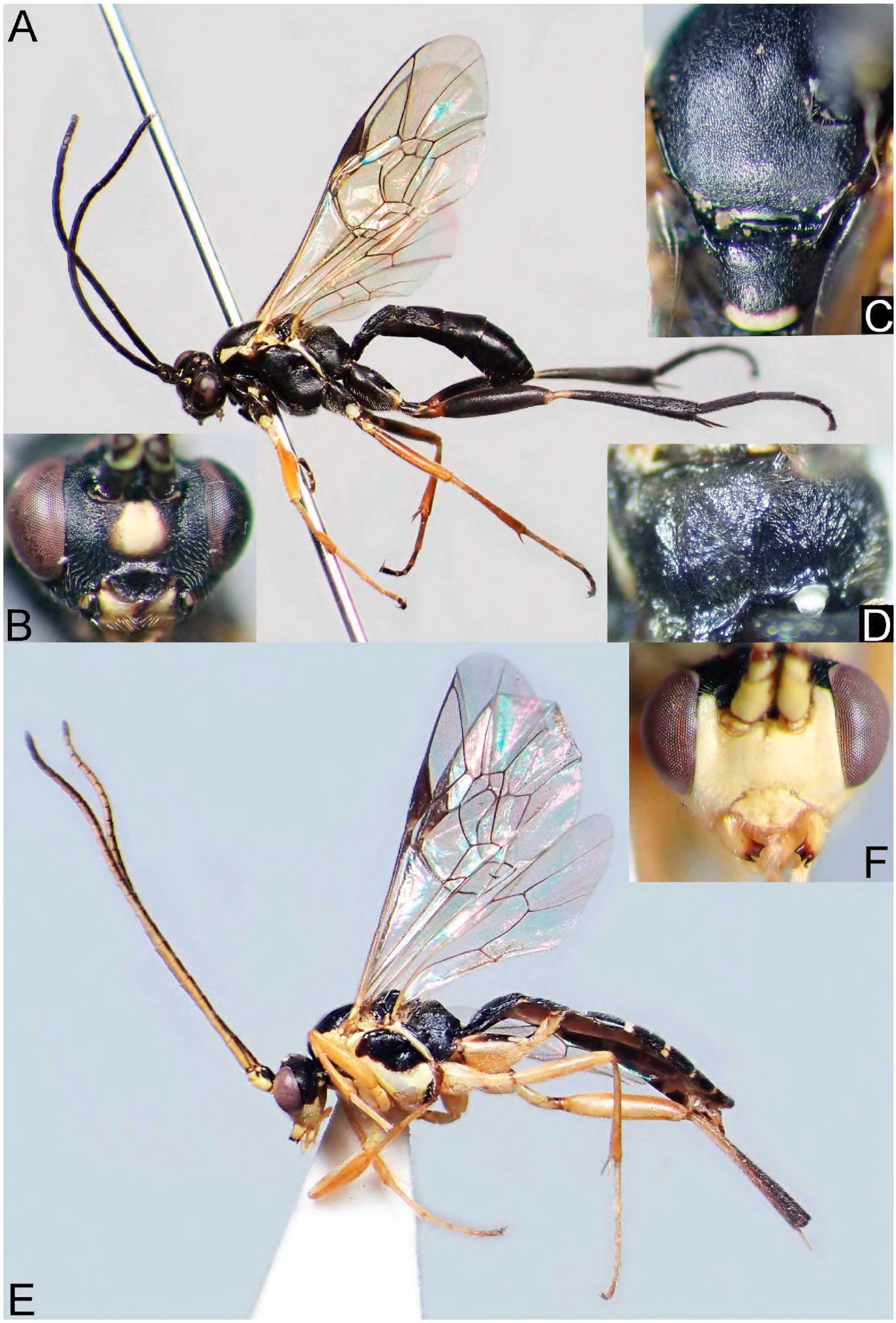

Figure 1. *Woldstedtius alpicola* sp. nov. (**A–D.** female, holotype; **E, F.** male, paratype) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

Head 0.51–0.54 (HT: 0.53) × as long as wide. Clypeus 2.0–2.35 (HT: 2.0) × as broad as high, slightly convex basally in lateral view. Face 2.1–2.4 (HT: 2.4) × as broad as high, densely punctate, convex medially in lateral view and separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 1B). Length of malar space 0.9–1.15 (HT: 0.9) × as long as basal mandibular width. POL 1.9–2.1 (HT: 1.9) × as long as OD. OOL 0.9–1.18 (HT: 0.9) × as long as OD. POL 1.86–1.95 (HT: 1.86) × as long as OOL. Antenna with 24–25 (HT: 24) flagellomeres. FL I 1.29–1.35 (HT: 1.35) × as long as FL II. MP IV1.42–1.53 (HT: 1.53) × as long as MP V.

Mesosoma. Lateral aspect of pronotum strigose anteriorly. Mesoscutum finely and densely punctate (separated by ca.1.0 × their diameter) (Fig. 1C). Scutellum finely and sparsely punctate (separated by ca.1.5–2.5 × their diameter) (Fig. 1C). Anterior part and lower half of mesopleuron coarsely and densely punctate. Speculum smooth. Sternaulus weakly impressed. Propodeum finely rugulose (Fig. 1D), rounded in lateral view and pleural carina entirely present. Fore wing length 7.4–8.5 (HT: 7.4) mm. Nervellus intercepted below middle. Hind femur 4.7–5.3 (HT: 4.7) × as long as maximum depth in lateral view. Hind tibia 7.5–8.0 (HT: 8.0) × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6: 0.4: 0.2: 0.2–0.3 (HT: 0.2).

Metasoma. T I rectangular in dorsal view (Fig. 9E), 1.4–1.5 (HT: 1.4) × as long as maximum width, irregular rugulose laterally, sometimes striate between latero-median carinae. Latero-median carina present basal ca. 0.5 of T I (Fig. 9E). T II 0.6–0.73 (HT: 0.73) × as long as maximum width, striate anteriorly and strigose laterally.

Coloration **(Fig. 1A–D).** Body (excluding wings and legs) black. Face with a large yellow spot medially. Palpi, subtegular ridge and mesepisternum yellow. Mandible yellow, except for apex and base. Lateral aspect of pronotum with a yellow spot posteriorly. Mesoscutum with yellow shoulder marks. Tegula tinged with yellow anteriorly. Scutellum with a yellow spot apically. Wings hyaline. Veins and pterostigma blackish-brown except for yellowish-brown wing base. Legs blackish-brown to black. Fore trochanter, trochantellus, apex of hind femur and base of hind tibia tinged with white. Fore femur, tibia and tarsomeres orange to brown. Apex of hind trochantellus and base of hind femur tinged with reddish-brown.

Male (n = 1). Similar to female. Body length (excluding antennae) 8.1 mm. Face 2.5 × as broad as high. Length of malar space 0.8 × as long as basal mandibular width. POL 2.2 × as long as OD. OOL 1.2 × as long as OD. POL 2.1 × as long as OOL. Inner orbits weakly divergent downward (Fig. 1F). Fore wing length 6.3 mm.

Coloration **(Fig. 1E, F).** Body (excluding wings and legs) black. Clypeus, palpi, face, ventral surface of antenna, malar space, propleuron, epicnemium, mesosternum, tegula, subtegular ridge and mesepisternum yellow. Gena tinged with yellow ventrally. Mandible yellow, except for apex. Lateral aspect of pronotum tinged with yellow ventrally and posteriorly. Mesopleuron with a large yellow marking, it enlarged anteriorly. Scutellum with a yellow spot apically. T IV to T VII with a transverse yellow band posteriorly. Wings hyaline. Veins and pterostigma brown to blackish-brown except for yellow wing base. Legs yellow to yellowish-brown. Hind coxa and trochanter each with a blackish-brown stripe dorsally. Hind trochantellus and tibia tinged with blackish-brown.

Distribution. Japan (Honshu).

Bionomics. Host unknown. Adults were collected in broad-leaved forest at altitudes of ca. 1,000–2,000 meters.

Etymology. The species name refers that this species inhabits alpine region.

Remarks. This species resembles *W. kuroashii* but can be distinguished from the latter by the following combination of character states: pleural carina of propodeum entirely present in both sexes (absent posteriorly in both sexes of *W. kuroashii*); propodeum finely rugulose in both sexes (coriaceous in both sexes of *W. kuroashii*); T I 1.4–1.5 × as long as maximum width in both sexes (1.1–1.25 in females, 1.14–1.26 in males of *W. kuroashii*). This species also resembles a Korean species, *W. pallidus* Balueva & Lee, 2016 (male is unknown), but can be distinguished by the following combination of character states in females: a large yellow median spot of face present (absent in *W. pallidus*); antenna with 24–25 flagellomeres (22–23 in *W. pallidus*); scutellum finely and sparsely punctate on coriaceous background (entirely coriaceous in *W. pallidus*); propodeum finely rugulose (coriaceous in *W. pallidus*).

Woldstedtius biguttatus (Gravenhorst, 1829)

Figs 2A–F, 9F

Bassus biguttatus Gravenhorst, 1829: 332.

Bassus rufipes Gravenhorst, 1829: 337. Name preoccupied.

Bassus confusus Woldstedt, 1874: 63. Synonymized by Morley (1906).

Syrphoctonus flavolineatus: Konishi et al. 2014: 491. Misident (at least in part).

Woldstedtius flavolineatus: Morishita et al. 2021: 53. Misident.

Materials examined. JAPAN: [Hokkaido] 1 F, Hokkaido, Nemuro, Shibetsu, Rubesu, 25–28 Aug 1971, K. Yamagishi leg. (MU); 1 F, Hokkaido, Sapporo, 20 May 1967, K. Kusigemati leg. (SEHU). [Honshu] 1 F, Gunma Pref., Katashina Vil., Marunuma, Yuzawa, 2 Jul 2008, K. Watanabe leg. (KPMNH); 1 F, Saitama Pref., Honjo City, Okubo-yama, 1 Apr 2001, N. Shimizu leg. (KPMNH); 1 F, Saitama Pref., Satte City, Makinoji, 6 Apr 2009, S. Yoshizawa leg. (KPMNH); 2 F, Tokyo, Chiyoda, Imperial Palace, Fukiagegyoen 20 May–19 Jun 1996, K. Konishi leg. (MT) (NSMT); 1 F, Tokyo, Chiyoda, Imperial Palace, Fukiagegyoen, Kajuen, 17–24 Sep 2009 (MT) (NSMT); 1 F & 1 M, ditto, 14–21 Oct 2009 (MT) (NSMT); 1 M, ditto, 13–20 Apr 2010 (MT) (NSMT); 1 F, ditto, 11–18 May 2010 (MT) (NSMT); 1 M, Tokyo, Chiyoda, Imperial Palace, Fukiagegyoen, Otakinagare, 29 Mar–6 Apr 2009 (MT) (NSMT); 1 F, ditto, 12–17 May 2011 (MT) (NSMT); 1 F, ditto, 17–24 May 2011 (MT)

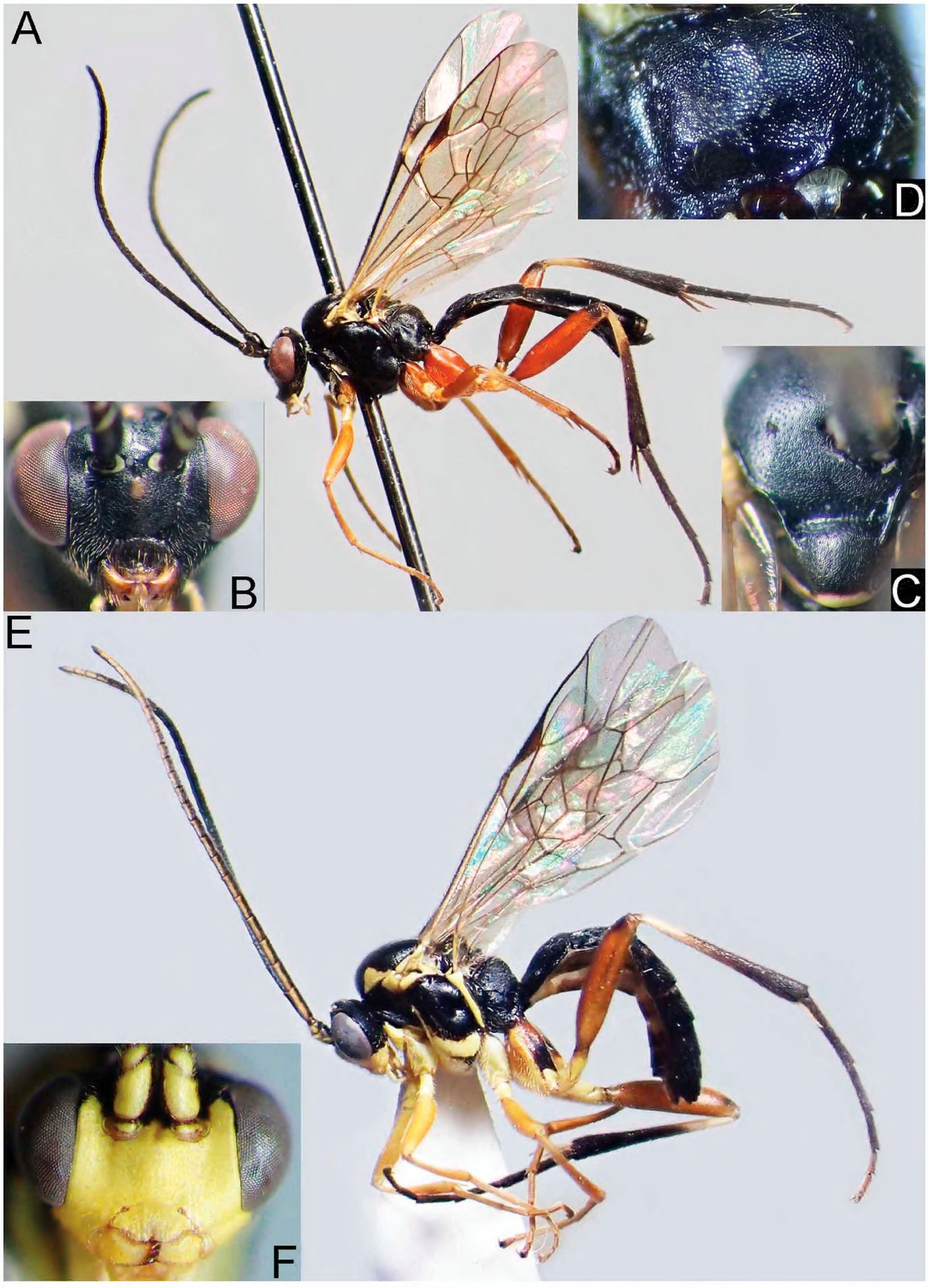

Figure 2. *Woldstedtius biguttatus* (Gravenhorst, 1829) (**A–D.** female; **E, F.** male) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

(NSMT); 1 F, Tokyo, Chiyoda, Imperial Palace, Biol. Inst., nr. Paddy field, 12–17 May 2011 (MT) (NSMT); 1 F, Tokyo, Chiyoda, Imperial Palace, Dokan-shinmichi, 7–14 Oct 2009 (MT) (NSMT); 1F & 1 M, ditto, 21–28 Oct 2009 (MT) (NSMT); 4 F & 1 M, ditto, 28 Oct–4 Nov 2009 (MT) (NSMT); 2 F & 1 M, ditto, 11–18 Nov 2009 (MT) (NSMT); 1 M, ditto, 18–24 Nov 2009 (MT) (NSMT); 1 F & 4 M, ditto, 24 Nov–7 Dec 2009 (MT) (NSMT); 1 M, ditto, 3–17 Mar 2010 (MT) (NSMT); 3 M, ditto, 29 Mar–6 Apr 2010 (MT) (NSMT); 2 F, ditto, 6–13 Apr 2010 (MT) (NSMT); 1 F, ditto, 27 Apr–4 May 2010 (MT) (NSMT); 3 F, ditto, 4–11 May 2010 (MT) (NSMT); 6 F & 2 M, ditto, 25 May–1 Jun 2010 (MT) (NSMT); 1 M, Tokyo, Chiyoda, Imperial Palace, Dokan-bori, 23 Mar 2010, K. Watanabe leg. (MT) (NSMT); 2 M, Tokyo, Ome City, Mt. Otsukayama, 1 Jun 2008, M. Irie leg. (KPMNH); 3 M, Tokyo, Ome City, Mt. Mitakesan, 1 Jun 2008, M. Gunji leg. (KPMNH); 1 F, Kanagawa Pref., Fujisawa City, Ishikawa, 11 May 2001, I. Waki leg. (NSMT); 1 F, Kanagawa Pref., Ebina City, Sagamigawa, 13 Apr 2006, M. Ooishi & R. Watanabe leg. (YPT) (KPMNH); 1 F, Kanagawa Pref., Chigasaki City, Serizawa, 10 May 2013, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Atsugi City, Funako, Tokyo University of Agriculture, 6 May–7 Jun 2016, Y. Kato & S. Koizumi leg. (MT) (KPMNH); 1 M, ditto, 22 Apr–16 May 2016, Y. Kato & S. Koizumi leg. (MT) (KPMNH); 1 M, Kanagawa Pref., Atsugi City, Tokyo University of Agriculture, 2 Apr 2009, H. Katahira leg. (KPMNH); 1 M, Kanagawa Pref., Oiso Town, Koma, Komayama, 16 Apr 2016, K. Watanabe leg. (KPMNH); 4 M, Kanagawa Pref., Nakai Town, Zoushiki, 16 Apr 2019, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Kiyokawa Vil., 4 Oct 2008, Y. Oogane leg. (KPMNH); 2 F, Kanagawa Pref., Hadano City, Koubouyama, 1 May 2016, K. Watanabe & H. Utsugi leg. (KPMNH); 2 M, ditto, 18 Apr 2010, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Hadano City, Chimura, Mt. Zukkoyama, 16 Apr 2017, K. Watanabe leg. (KPMNH); 1 M, ditto, 7 May 2017, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Tennoujione, 29 Jun 2013, (FIT) (KPMNH); 3 M, Kanagawa Pref., Kaisei Town, Kanaishima, 22 Mar 2016, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Odawara City, Kuno, 24 Mar 2014, K. Watanabe leg. (KPMNH); 1 M, ditto, 24 Mar 2014, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Odawara City, Kamisoga, 29 Apr 2017, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Yamakita Town, Hinokiboramaru, 6 Aug 2014, T. Taniwaki leg. (KPMNH); 1 F, Kanagawa Pref., Yamakita Town, Mt. Oomuroyama–Mt. Kanyuudousan, 15 Jun 2008, H. Kawai leg. (KPMNH). 1 F, Yamanashi Pref., Koshu City, Enzanushioku, Sagashio, 12 Jun 2010, K. Watanabe leg. (KPMNH); 1 F, Yamanashi Pref., Hokuto City, Masutomi, Biwakubo-sawa, 28 Jul 2007, K. Watanabe leg. (KPMNH); 1 F, Yamanashi Pref., Yamanakako Vil., Hirano, Mikuni-toge, 8 Aug 2020, S. Morishita leg. (TMNH); 3 F, Shizuoka Pref., Shizuoka City, Umegashima, 3 Jun 2001, T. Sugiyama leg. (YPT) (MU); 2 F, ditto, 18 Jun 2001, T. Sugiyama leg. (YPT) (MU); 2 F, ditto, 18 Jun–2 Jul 2001, T. Sugiyama leg. (MT) (MU); 1 F, ditto, 17 Jul–5 Aug 2001, T. Sugiyama leg. (MT) (MU); 1 F, Aichi Pref., Shitara Town, Tsuguhonsawa, 7 May–26 Jun 2020, S. Morishita leg. (MT) (TMNH); 1 F, ditto, 17 Jun 2019, S. Morishita leg. (TMNH); 1 F, ditto, 5 Jul 2019, S. Morishita leg. (TMNH); 1 F, Aichi Pref., Shinshiro City, Tsukudeiwanami, 17 May 2019, S. Morishita leg. (TMNH); 1 M, ditto, 2 May 2019, S. Morishita leg. (TMNH); 3 F & 4 M, Aichi Pref., Toyohashi City, Hosoya, Kitahosoya, 6 Apr 2019, S. Morishita leg. (TMNH); 1 F, Aichi Pref., Toyohashi City, Unoya, Nabeyamashita, 10 Apr 2019, S. Morishita leg. (TMNH); 1 F & 1 M, ditto, 30 Apr 2019, S. Morishita leg. (TMNH); 2 M, Aichi Pref., Toyohashi City, Oiwa, Taimatsu-toge, 6 Apr 2021, S. Morishita leg. (TMNH); 1 F, Aichi Pref., Toyohashi City, Imure, Takayama, 2 Jun–6 Jun 2019, S. Morishita leg. (MT) (TMNH); 1 F, Aichi Pref., Toyohashi City, Nishiiwata, 12 Jul 2018, S. Morishita leg. (TMNH); 1 M, ditto, 3 May 2019, S. Morishita leg. (TMNH); 3 M, Aichi Pref., Toyokawa City, Mikami-cho, 15 Sep 2019, S. Morishita leg. (TMNH); 1 M, Aichi Pref., Kasugai City, Takagi, 19 May 2017, M. Sugiura leg. (MU); 2 F, Aichi Pref., Toyota City, Sanage, 30 Apr–6 May 2002, M. Kiyota leg. (MT) (MU); 1 F, Aichi Pref., Asuke Town, Tanoshiri, 15–24 May 2005, Y. Nishimura leg. (MT) (MU); 1 F, ditto, 15–21 Jun 2005, Y. Nishimura leg. (MT) (MU); 1 F, ditto, 15–21 Jun 2005, J. Yamagiwa leg. (MT) (MU); 1 F, ditto, 13–19 Jul 2005, Y. Nishimura leg. (MT) (MU); 1 F, Aichi Pref., Nisshin City, Komenogi, 28 May–3 Jun 2011, H. Seo leg. (MT) (MU); 1 F, Aichi Pref., Nisshin City, Nokata, 28 May–3 Jun 2011, H. Seo leg. (MT) (MU); 1 F, Aichi Pref., Ichinomiya City, 14–20 Oct 2006, C. Ueshima leg. (MT) (MU); 1 M, Gifu Pref., Kani City, Katabira 3–9 Apr 2004, K. Ito leg. (MT) (MU); 1 M, ditto, 10–16 Apr 2004, K. Yamagishi leg. (MT) (MU); 2 F, ditto, 17–23 Apr 2004, K. Ito leg. (MT) (MU); 1 M, ditto, 1–7 May 2004, K. Ito leg. (MT) (MU); 1 M, ditto, 15–21 May 2004, K. Ito leg. (MT) (MU); 1 F, Nagano Pref., Kawakami Vil., Azusayama, 14 Jun 2015, K. Watanabe leg. (KPMNH); 1 F, Nagano Pref., Nagawa Town, Daimon, 27 Aug 2011, S. Fujie leg. (KPMNH); 1 F, Nagano Pref., Otaki Vil., Mt. Ontakesan, Hakkaisan, 8 Aug 2010, K. Watanabe leg. (KPMNH); 1 F, ditto, 25 Jun–15 Jul 2015, S. Shimizu leg. (MT) (KPMNH); 1 F, Toyama Pref., Mt. Jodosan, 7 Jun 1972, M. Watanabe leg. (KPMNH); 1 M, Toyama Pref., Toyama City, Inonedani, 7–14 Jul 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, ditto, 8–15 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, ditto, 15–22 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, Toyama Pref., Toyama City, Kamegai, 1–8 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, ditto, 8–15 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, Toyama Pref., Toyama City, Jurodani, 7–14 Jul 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, Toyama Pref., Nanto City, Kamimomose, 11–18 Aug 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, ditto, 1–8 Sep

2009, M. Watanabe leg. (MT) (KPMNH); 4 M, ditto, 15–29 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 2 F, Ishikawa Pref., Nomi City, Mitsukuchi, 30 Apr–13 May 2011, R. Ishiguro leg. (MT) (MU); 1 F, ditto, 6–21 Oct 2011, H. Fukutomi leg. (MT) (MU); 1 F, Ishikawa Pref., Hakusan City, Sannomiya, 17–23 May 2009, H. Fukutomi leg. (MT) (MU); 1 F, ditto, 24–30 May 2009, H. Fukutomi leg. (MT) (MU); 1 F & 1M, Mie Pref., Taiki Town, Takihara, 20–31 May 2019, T. Nishimura leg. (MT) (MU); 1 M, Kyoto Pref., Yawata City, Yawatahayashinomoto, 15 May 2015, K. Watanabe leg. (KPMNH); 2 F, Osaka Pref., Chihayaakasaka Vil., Mt. Kongosan, 7–15 Jul 2012, S. Fujie leg. (MT) (KPMNH); 1 F, Hyogo Pref., Kobe City, Motoyama Town, Hokura-jinjya, 5 May 2012, K. Watanabe leg. (KPMNH); 1 F, Tottori Pref., Wakasa Town, Mt. Hyonosen, 17 Jul 2011, K. Watanabe leg. (KPMNH). [Shikoku] 1 F & 1 M, Tokushima Pref., Zennyuji-toh, 13–22 May 2003, H. Otsuka leg. (MT) (MU). [Kyushu] 1 F, Kagoshima Pref., Sakurajima, 13 May 1973, K. Kusigemati leg. (SEHU); 1 F, Kagoshima Pref., Terayama, 19 Apr 1973, K. Kusigemati leg. (SEHU); 1 F, Kagoshima Pref., Uearata, 18 Oct 1973, K. Kusigemati leg. (SEHU). BULGARIA: 1 M, Batak, 20 Jul 1966 (ZSM). GERMANY: 1 M, Stolzenau, 8 Aug 1945 (ZSM). RUSSIA: 1 F, Altay, Lake Telezkoe, Chulishman, 6 Aug 1989, A. Tereshkin leg. (ZSM).

Description. Female (n = 100). Body length 4.5–7.2 mm, weakly polished, coriaceous and covered with silver setae.

Head 0.5–0.54 × as long as wide. Clypeus 2.0–2.2 × as broad as high, slightly convex basally in lateral view. Face 2.0–2.35 × as broad as high, densely punctate, convex medially in lateral view, separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 2B). Length of malar space 1.0–1.1 × as long as basal mandibular width. POL 1.8–2.3 × as long as OD. OOL 1.0–1.3 × as long as OD. POL 1.7–2.1 × as long as OOL. Antenna with 22–25 flagellomeres. FL I 1.25–1.33 × as long as FL II. MP IV 1.25–1.33 × as long as MP V.

Mesosoma. Lateral aspect of pronotum rugulose anteriorly. Mesoscutum finely and sparsely punctate (separated by ca. 1.5–3.0 × their diameter) (Fig. 2C). Scutellum finely and sparsely punctate (separated by ca. 1.5–2.5 × their diameter) (Fig. 2C). Anterior and lower parts of mesopleuron coarsely and sparsely punctate. Sternaulus weakly impressed. Propodeum rounded in lateral view, without rugae (Fig. 2D), without carinae except for anterior part of pleural carina. Fore wing length 3.8–6.5 mm. Nervellus intercepted below middle. Hind femur 4.22–4.5 × as long as maximum depth in lateral view. Hind femur 8.0–8.5 × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6: 0.4–0.5: 0.2–0.3: 0.3.

Metasoma. T I rectangular in dorsal view (Fig. 9F), 1.0–1.2 × as long as maximum width, rugulose laterally. Latero-median carina present basal ca. 0.5 of T I. T II 0.66–0.88 × as long as maximum width, striate anteriorly and strigose laterally.

***Coloration* (Fig. 2A–D).** Body (excluding wings and legs) black. Face sometimes with a small yellow or brown median spot. Palpi, tegula and upper part of mesepisternum yellow. Mandible yellow, except for apex and base. Lateral aspect of pronotum with a yellow spot posteriorly. Subtegular ridge tinged with yellow anteriorly. Scutellum with a yellow spot apically. Wings hyaline. Veins and pterostigma brown to blackish-brown except for yellowish-brown wing base. Legs orange. Apex of fore coxa and apex of hind femur tinged with black. Trochanters and trochantelli yellow. Hind tibia and tarsomeres black. Base of hind tibia tinged with white.

Male (n = 71). Similar to female. Inner orbits weakly divergent downward (Fig. 2F). Length of malar space 0.83–1.0 × as long as basal mandibular width.

***Coloration* (Fig. 2E, F).** Body (excluding wings and legs) black. Clypeus, palpi, face, ventral surface of antenna, malar space, propleuron, epicnemium, tegula, subtegular ridge and mesepisternum yellow. Gena tinged with yellow ventrally. Mandible yellow, except for apex. Lateral aspect of pronotum with a yellow spot ventrally and posteriorly. Mesoscutum with yellow shoulder marks. Mesopleuron with a yellow marking ventrally. Scutellum with a yellow spot apically. T III and T IV each with a pair of yellow spots anteriorly (sometimes these spots united into a single spot). Wings hyaline. Veins and pterostigma brown to blackish-brown except for yellowish-brown wing base. Legs yellow. Fore and mid femora, tibiae and tarsi orange. Hind coxa with a blackish-brown stripe dorsally. Hind femur brown to blackish-brown. Base of hind trochantellus tinged with blackish-brown. Hind tibia and tarsomeres black. Base of hind tibia tinged with whitish-yellow.

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu). Outside Japan, this species is widely distributed in Palearctic region (Yu et al. 2016).

Bionomics. Host unknown in Japan. Outside of Japan, the following three hoverfly species have been recorded as hosts: *Eupeodes lapponicus* (Zetterstedt, 1838); *Neocnemodon fulvimanus* (Zetterstedt, 1843); *Sphaerophoria scripta* (Linnaeus, 1758) (Yu et al. 2016). *Anthonomus pomorum* (Linnaeus, 1758) and *Loxostege sticticalis* (Linnaeus, 1761) have also been recorded as hosts (Yu et al. 2016), but are considered doubtful records. Most adults were collected from various open habitats (e.g., grasslands, meadows and paddy fields).

Remarks. This is the first record of this species from Japan. This species resembles *W. flavolineatus*, but can be distinguished from the latter by the following combination of character states: face entirely black or black with a small yellow or brown median spot in females (black with a large yellow median spot in females of *W. flavolineatus*); pronotum black with yellow ventral corner in males (black with yellow ventral and hind parts in males of *W. flavolineatus*); yellow shoulder marks absent in females (present in females of *W. flavolineatus*); mesopleuron with a yellow marking ventrally in males (with a large yellow marking; it is enlarged anteriorly in males of *W. flavolineatus*).

Woldstedtius citropectoralis (Schmiedeknecht, 1926)

Bassus abdominator Bridgman, 1886: 336. Name preoccupied.
Homocidus citropectoralis Schmiedeknecht, 1926: 3412.

Material examined. No specimens available.

Distribution. Japan (Kunashiri Is.). Outside Japan, this species is widely distributed in Holarctic region (Yu et al. 2016).

Remarks. This species was recorded from Japan by Manukyan (2007), but no additional specimens were found in this study.

Woldstedtius flavolineatus (Gravenhorst, 1829)

Remarks. This species is divided into two subspecies, *W. flavolineatus flavolineatus* and *W. f. nigroscutellatus* (Habermehl, 1925). The latter subspecies has been recorded from Germany and Netherlands (Habermehl 1925; Teunissen 1948). Klopfstein (2014) noted this subspecies could not be examined by her because type specimens were not available. Judging from the original description of the latter (Habermehl 1925), this subspecies could readily be synonymized under the former.

Woldstedtius flavolineatus flavolineatus (Gravenhorst, 1829)

Figs 3A–F, 9G

Bassus flavolineatus Gravenhorst, 1829: 337.
Homocidus flavolineatus Uchida, 1957: 251.
Bassus interruptus Holmgren, 1858: 359. Synonymized by Thomson (1890).
Bassus bimaculatus Holmgren, 1858: 360. Synonymized by Thomson (1890).
Bassus agilis Cresson, 1868: 111. Synonymized by Dasch (1964).
Bassus frontalis Cresson, 1868: 111. Synonymized by Dasch (1964).
Mesoleius junctus Provancher, 1883: 10. Synonymized by Dasch (1964).

Materials examined. Italy: 1 F Sud-tirol, Coltina d'Ampezzo, 29 Jul 1933, E. Bauer leg. (ZSM). Bulgaria: 1 M Vitoscha, 24 Jul 1966 (ZSM).

Diagnosis. Body weakly polished. Inner orbits almost parallel in females, weakly divergent downward in males. Antenna with 22–24 flagellomeres in females, 22–25 in males. Propodeum without rugae (Fig. 3D), without carinae except for anterior part of pleural carina. T I entirely coriaceous, rectangular in dorsal view (Fig. 9G). Latero-median carina of T I present basal ca. 0.5 of T I. Face black with a large yellow median spot in females (Fig. 3B), entirely yellow in males (Fig. 3F). Lateral aspect of pronotum black with ventral and posterior yellow spots in females (Fig. 3A), black with yellow ventral and posterior areas in males (Fig. 3E). Mesopleuron entirely black in females (Fig. 3A), black with a large yellow marking, it enlarged anteriorly in males (Fig. 3E). Shoulder marks of mesoscutum yellow in both sexes (Fig. 3C, E). Scutellum black with an apical yellow spot in both sexes (Fig. 3C). Hind coxa entirely orange in females (Fig. 3A), yellow with brown base in males (Fig. 3E). Hind trochanter yellow in females (Fig. 3A), yellow with a brown dorsal spot in males (Fig. 3E). Metasoma entirely black in females, bases of T III and T IV each with a transverse yellow band in males.

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu). Outside Japan, this species is widely distributed in Holarctic, Oriental, Oceanic, and Neotropical region (Yu et al. 2016).

Bionomics. In Japan, one hover fly species, *Episyrphus balteatus* (De Geer, 1776) is recorded as a host (Uchida 1957).

Remarks. No additional specimen of this species from Japan was found in this study. Some or all previous records of this species from Japan may be based on misidentification of *W. biguttatus*.

Woldstedtius karafutensis (Uchida, 1957)

Figs 4A–F, 9H

Homocidus karafutensis Uchida, 1957: 252.

Materials examined. ***Type series*:** RUSSIA: 1 F (***holotype***), Sakhalin Is., Tarandomari, 25 Jul 1934, C. Watanabe & T. Inoue leg. (SEHU); JAPAN: [Hokkaido] 1 F (***paratype***), Hokkaido, Sapporo, 6 Jul 1954, Townes family leg. (SEHU). ***Non-types*:** JAPAN: [Honshu] 1 F, Fukushima Pref., Showa Vil., Mt. Hakase, 24 Aug–19 Sep 1998, T. Muroi leg. (MT) (MU); 1 F, Yamagata Pref., Mamurogawa Town, Azusayama, 5 Sep 2009, Y. Matsubara & K. Fukuda leg. (MT) (KPMNH); 2 F, Shizuoka Pref., Shizuoka City, Umegashima, 3 Jun–16 Jul 2001, T. Sugiyama leg. (MT) (MU); 2 F, ditto, 17 Jul–5 Aug 2001, T. Sugiyama leg. (MT) (MU); 1 M, Shizuoka Pref., Honkawane Town, Yamainudan, 14 Jun 2008, K. Watanabe leg. (KPMNH); 2 F, Gifu Pref., Kani City, Katabira, 8–14 May 2004, K. Yamagishi leg. (MT) (MU); 1 F, Toyama Pref., Nanto City, Togamura, Kamimomose, 4–11 Aug 2009, M. Watanabe leg. (MT) (KPMNH); 1 F, Ishikawa Pref., Kaga City, Mt. Kariyasuyama, 7–18 Jul 2002, K. Esaki leg. (MT) (TMNH); 1 F, Ishikawa Pref., Hakusan City, Sannomiya, 6–18 Sep 2009, H. Fukutomi leg. (MT) (MU); 1 M, Ishikawa Pref., Hakusan City, Togadani, 18 May–4 Jun 2010, H. Fukutomi leg. (MT) (MU); 1 F, Hyogo Pref., Kami Town, Ojiro-ku, Niiya, Mikata-kogen, 26 Jun–18 Jul 2011, S. Fujie leg. (MT) (KPMNH).

Description. Female (n = 14). Body length 4.1–6.0 mm, polished, coriaceous, covered with silver setae.

Head 0.5 × as long as wide. Clypeus 2.1–2.4 × as broad as high, flat in lateral view. Face 1.88–2.2 × as broad as high, densely punctate, convex medially in lateral view, separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 4B). Length of malar space 1.1–1.15× as long

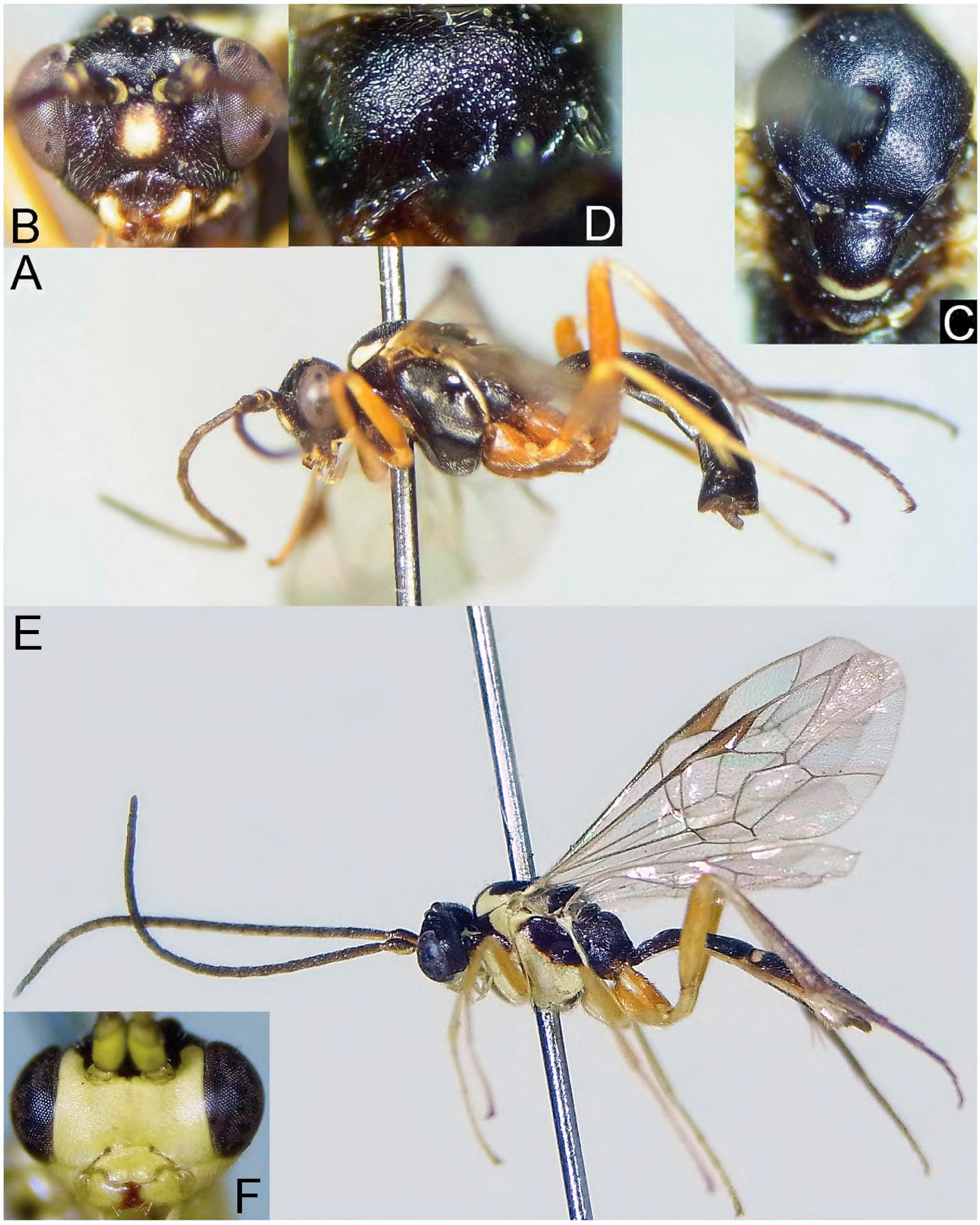

Figure 3. *Woldstedtius flavolineatus flavolineatus* (Gravenhorst, 1829) (**A–D.** female; **E, F.** male) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

as basal mandibular width. POL 2.0–2.1 × as long as OD. OOL 1.0–1.2 × as long as OD. POL 2.0–2.2 × as long as OOL. Antenna with 20–21 flagellomeres. FL I 1.15–1.35 × as long as FL II. MP IV 1.45–1.66 × as long as MP V.

Mesosoma. Lateral aspect of pronotum rugulose anteriorly. Mesoscutum densely punctate (separated by ca. 0.5–1.0 × their diameter) (Fig. 4C). Scutellum finely and sparsely punctate (separated by ca. 1.5–2.0 × their diameter). Lower part of mesopleuron coarsely and sparsely punctate. Sternaulus indistinct. Propodeum without rugae and carinae (Fig. 4D), rounded in lateral view. Fore wing length 4.0–5.0 mm. Nervellus intercepted below middle.

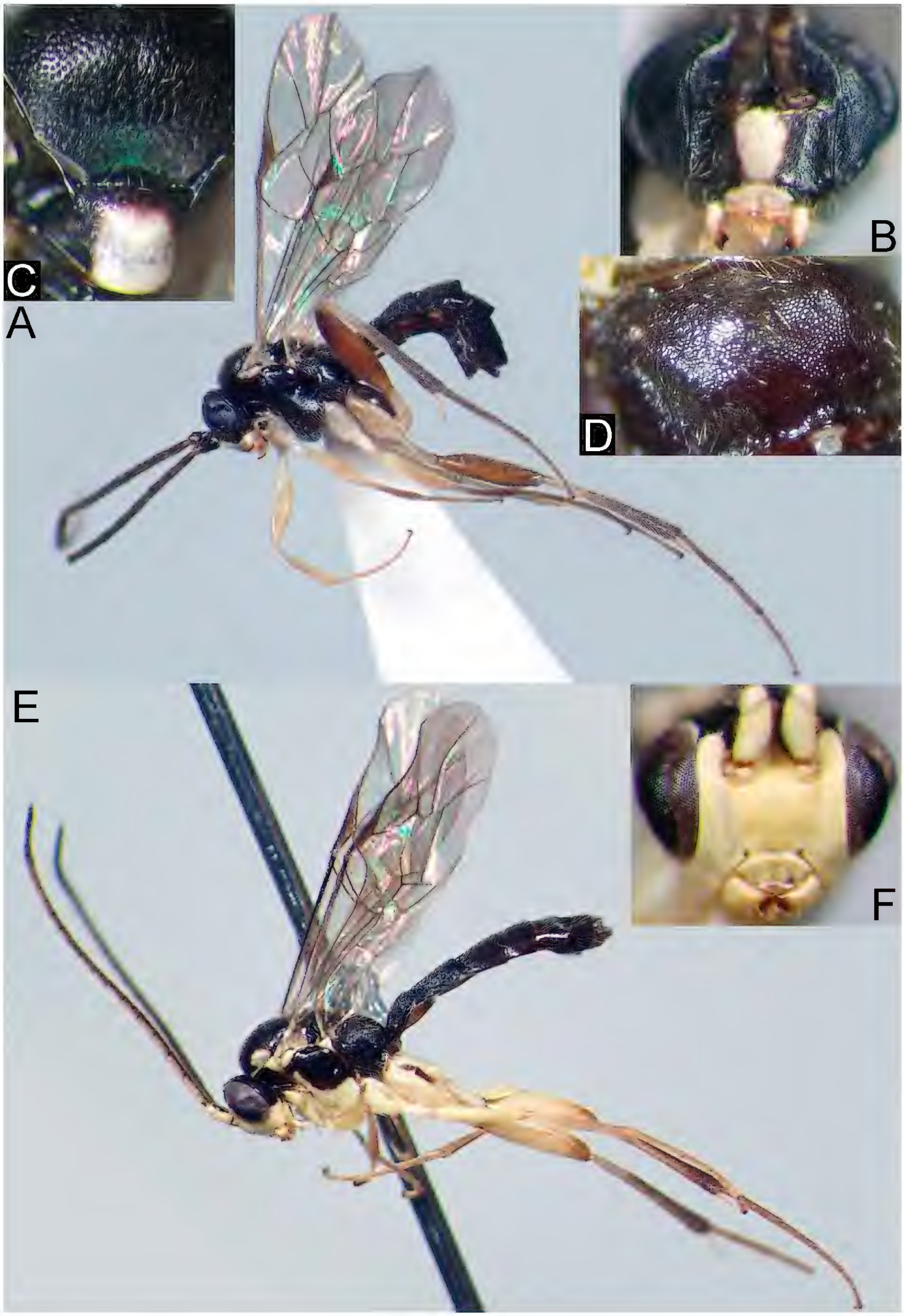

Figure 4. *Woldstedtius karafutensis* (Uchida, 1957) (**A–D.** female; **E, F.** male) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

Hind femur 3.75–4.0 × as long as maximum depth in lateral view. Hind tibia 8.0–9.5 × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6: 0.5: 0.3: 0.25–0.3.

Metasoma. T I square in dorsal view (Fig. 9H), 1.0–1.1 × as long as maximum width, rugulose laterally. Latero-median carina present basal ca. 0.3 of T I (Fig. 9H). T II 0.86–1.0 × as long as maximum width, strigose except for posterior margin smooth.

***Coloration* (Fig. 4A–D).** Body (excluding wings and legs) black to blackish-brown. Face with a large white median spot (this spot connected with white clypeus). Clypeus, palpi, tegula, subtegular ridge, upper mesepisternum and scutellum white. Mandible white, except for apex and base. Lateral aspect of pronotum with a white spot posteriorly. Antenna brown. Veins and pterostigma yellowish-brown to brown. Legs whitish-yellow. Hind coxa with a dorsal blackish-brown stripe. Hind femur brown. Hind tibia and tarsomere black. Base of hind tibia tinged with white.

Male (n = 2). Similar to female. Inner orbits weakly divergent downward (Fig. 4F).

***Coloration* (Fig. 4E, F).** Body (excluding wings and legs) black to blackish-brown. Clypeus, palpi, face, ventral surface of antenna, malar space, propleuron, epicnemium, mesosternum, tegula, subtegular ridge, upper mesepisternum and scutellum white. Gena tinged with white ventrally. Mandible white except for apex. Lateral aspect of pronotum tinged with white ventrally and posteriorly. Mesoscutum with white shoulder marks. Mesopleuron with a large white marking; it is enlarged anteriorly. Wings hyaline. Veins and pterostigma yellowish-brown to brown. Legs white. Fore and mid tarsi, apex of hind trochantellus, base and apex of hind femur and hind tarsomeres brown. Hind coxa with a dorsal brown stripe. Hind tibia tinged with brown.

Distribution. Japan (Hokkaido and Honshu). Outside Japan, this species has been recorded from Russia and South Korea (Balueva and Lee 2016 and Yu et al. 2016).

Bionomics. Host unknown.

Remarks. This is the first record of this species from Honshu.

Woldstedtius kuroashii (Uchida, 1957)

Figs 5A–F, 9B, I

Homocidus flavolineatus var. *kuroashii* Uchida, 1957: 251.
Syrphoctonus holarcticus Diller, 1969: 548. Syn. nov.

Materials examined. ***Type series*:** JAPAN: [Honshu] 1 F (***holotype*** of *H. flavolineatus* var. *kuroashii*), Nagano Pref., Mt. Norikura, 30 Jul 1954, Townes family leg. (AEIC). GERMANY: 1 F (***paratype*** of *S. holarcticus*), Ober-Bayern, Garmisch, 21 Jul 1926, E. Bauer leg. (ZSM). ***Non-types*:** JAPAN: [Hokkaido] 4 F, Hokkaido, Hidaka Town, Uenzaru-gawa, 10 Jul–1 Aug 2007, A. Ueda leg. (MT) (KPMNH); 1 M, Hokkaido, Sapporo City, Mt. Soranumadake, 14 Jun–4 Jul 2007, A. Ueda leg. (MT) (KPMNH); 1 F, Hokkaido, Kamikawa Town, Ginsendai, 1 Aug 2021, K. Watanabe leg. (TMNH). [Honshu] 1 F, Fukushima Pref., Kitakata City, Yamato, Zouriduka–Mt. Iide, 11 Jul 2013, K. Yoshiga leg. (KPMNH); 1 M, Tochigi Pref., Kuriyama Vil., Yamato, Kinunuma, 1–14 Jul 2004, H. Makihara leg. (MT) (KPMNH); 3 F, Gunma Pref., Tsumagoi Vil., Kanbara, Takaminekogen, 3 Sep 2015, K. Watanabe leg. (KPMNH); 1 M, Niigata Pref., Nagaoka City, Suyoshi, Mt. Nokogiriyama, 7 Jun 2014, S. Shimizu leg. (KPMNH); 1 F, Tokyo, Chiyoda, Imperial Palace, Fukiagegyoen, Otakinagare, 14–26 Apr 2011 (MT) (NSMT); 2 M, Tokyo, Ome City, Mt. Mitakesan, 1 Jun 2008, M. Gunji leg. (KPMNH); 1 M, Kanagawa Pref., Fujino Town, Mt. Jinbayama, 7 Jun 2008, K. Watanabe leg. (KPMNH); 1 M, Kanagawa Pref., Hadano City, Chimura, Mt. Zukkoyama, 16 Apr 2017, K. Watanabe leg. (KPMNH); 1 M, Kanagawa Pref., Hakone Town, Mt. Kamiyama, 21 Jun 2010, M. Takakuwa leg. (KPMNH); 1 M, Kanagawa Pref., Yamakita Town, Mt. Komotsurushiyama, 23 Jul 2014, T. Taniwaki leg. (KPMNH); 1 M, Kanagawa Pref., Yamakita Town, Mt. Hinokiboramaru, 17 Jul 2014, T. Taniwaki leg. (KPMNH); 1 F, Yamanashi Pref., Fujiyoshida City, Takizawarindo, 7–11 Sep 2017 A. Owaki leg. (MT) (KPMNH); 1 F, Yamanashi Pref., Narusawa Vil., Fujirindo, 5 Sep 2015 K. Watanabe leg. (KPMNH); 1 F, Shizuoka Pref., Shizuoka City, Mt. Tyausudake, 28 Jul 1970, H. Takizawa leg. (SEHU); 1 F, Shizuoka Pref., Honkawane Town, Yamainudan, 14 Jun 2008, K. Watanabe leg. (KPMNH); 6 M, ditto, 14 Jun 2008, K. Watanabe leg. (KPMNH); 1 M, Gifu Pref., Kani City, Katabira, 17–23 Apr 2004, K. Ito leg. (MT) (MU); 2 F, Nagano Pref., Otaki Vil., Mt. Ontakesan, Tanohara, 8 Aug 2007, K. Watanabe leg. (KPMNH); 1 M, Nagano Pref., Otaki Vil., Mt. Ontakesan, Hakkaisan, 6 Aug 2010, K. Watanabe leg. (TMNH); 1 F, ditto, 7 Aug 2010, K. Watanabe leg. (TMNH); 1 F, ditto, 5–9 Aug 2010, K. Watanabe leg. (MT) (KPMNH); 7 M, ditto, 5–9 Aug 2010, K. Watanabe leg. (MT) (KPMNH); 1 F, Toyama Pref., Toyama City, Inonedani, 21–28 Jul 2009, M. Watanabe leg. (MT) (KPMNH); 1 F, ditto, 11–16 Aug 2009, M. Watanabe leg. (MT) (KPMNH); 1 F, ditto, 1–8 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 F, ditto, 8–15 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 6 F, ditto, 15–22 Sep 2009, M. Watanabe leg. (MT) (KPMNH); 1 F, Toyama Pref., Toyama City, Jurodani, 11–16 Aug 2009, M. Watanabe leg. (MT) (KPMNH); 1 M, Ishikawa Pref., Hakusan City, Sannomiya, 15 Oct–6 Nov 2009, H. Fukutomi leg. (MT) (MU); 1 F, Ishikawa Pref., Hakusan City, Yawata, 7–24 Oct 2009, H. Fukutomi leg. (MT) (MU); 1 M, Fukui Pref., Ikeda Town, Mizuumi, Mt. Hekosan, 18 Jun 2016, S. Shimizu leg. (KPMNH); 1 F, Hyogo Pref., Sasayama City, Mt. Koganegadake, 14 May 2014, Y. Ueyama leg. (KPMNH)

Description. Female (n = 33). Body length 5.5–8.5 mm, polished, coriaceous. covered with silver setae.

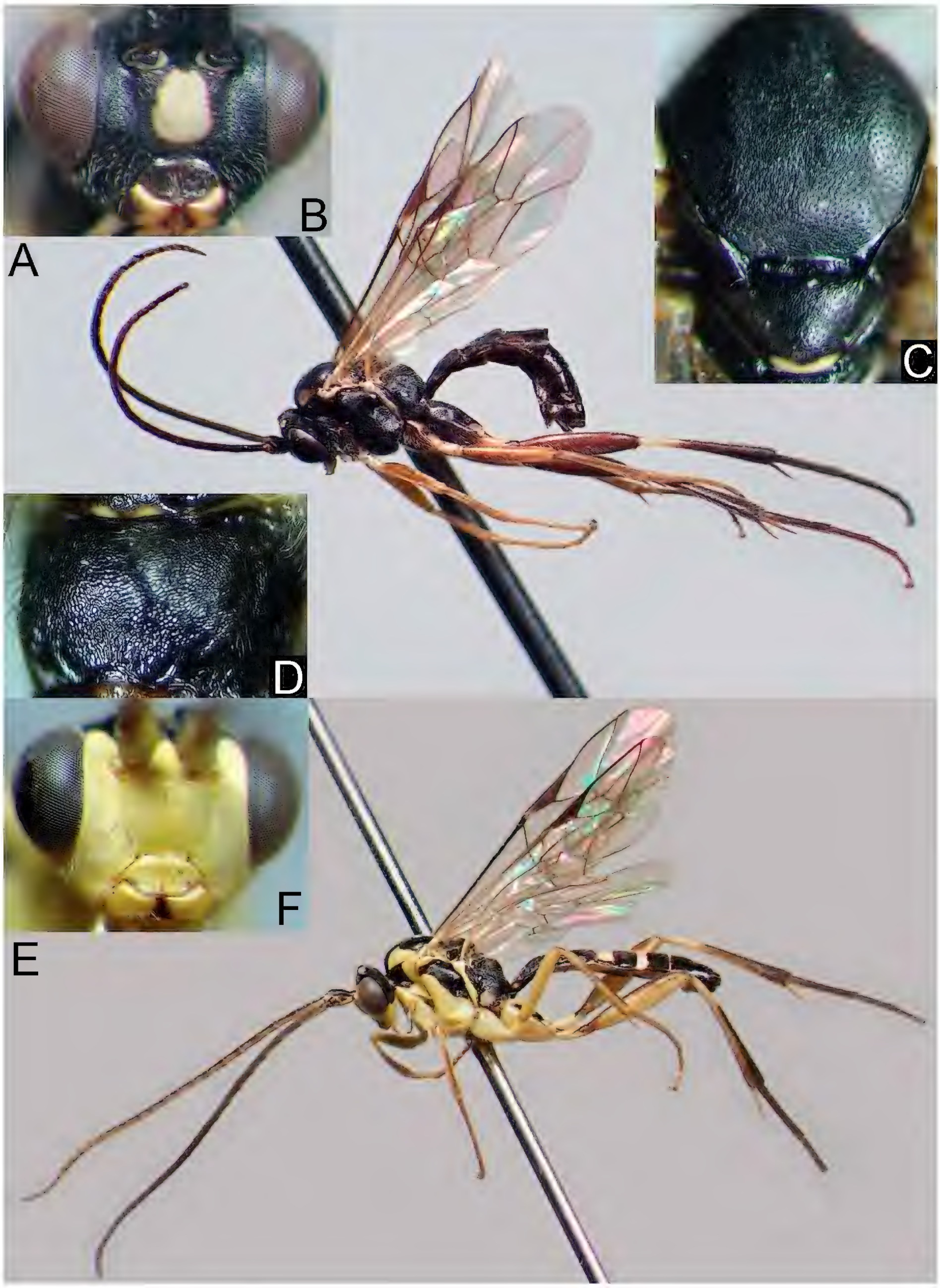

Figure 5. *Woldstedtius kuroashii* (Uchida, 1957) (**A–D.** female; **E, F.** male) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

Head 0.5–0.53 × as long as wide. Clypeus 2.0–2.3 × as broad as high, convex basally in lateral view. Face 2.2–2.3 × as broad as high, densely punctate, convex medially in lateral view (Fig. 9B), separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 5B). Length of malar space 1.0–1.2 × as long as basal mandibular width. POL 2.16–2.3 × as long as OD. OOL 1.0–1.38 × as long as OD. POL 1.86–2.1 × as long as OOL. Antenna with 23–25 flagellomeres. FL I 1.25–1.3 × as long as FL II. MP IV 1.2–1.29 × as long as MP V.

Mesosoma. Lateral aspect of pronotum rugulose or rarely strigose anteriorly. Mesoscutum finely and densely punctate (separated by ca. 1.0 × their diameter) (Fig. 5C). Scutellum finely and sparsely punctate (separated by ca. 1.5–2.5 × their diameter) (Fig. 5C). Mesopleuron coarsely and sparsely punctate except for speculum. Sternaulus weakly impressed. Propodeum rounded in lateral view, without rugae (Fig. 5D), without carinae except for anterior part of pleural carina. Fore wing length 5.8–6.9 mm. Nervellus intercepted below middle. Hind femur 4.0–4.5 × as long as maximum depth in lateral view. Hind tibia 7.8–8.4 × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6: 0.4–0.5: 0.3: 0.2–0.3.

Metasoma. T I rectangular in dorsal view (Fig. 9I), 1.1–1.25 × as long as maximum width, rugulose laterally. Latero-median carina present on basal ca. 0.5 of T I (Fig. 9I). T II 0.65–0.8 × as long as maximum width, striate anteriorly and strigose laterally.

Coloration **(Fig. 5A–D).** Body (excluding wings and legs) black. Face with a large whitish-yellow median spot (this spot rarely obscured). Palpi, tegula, subtegular ridge and mesepisternum yellow. Mandible whitish-yellow except for apex and base. Lateral aspect of pronotum with a whitish-yellow spot posteriorly. Mesoscutum with whitish-yellow shoulder marks (these marks rarely disappeared). Scutellum with a whitish-yellow spot apically. Veins and pterostigma brown to blackish-brown except for yellow wing base. Legs blackish-brown to black. Apex of fore coxa and base of hind tibia tinged with white. Trochanters and trochantelli white. Femora, fore and mid tibiae and tarsi sometimes (including paratype of *W. holarcticus*) orange to brown. Fore and mid coxae each with a white stripe dorsally (this stripe often obscured). Base of hind femur tinged with reddish-brown.

Male (n = 26). Similar to female. Inner orbits weakly divergent downward (Fig. 5F). Antenna with 22–25 flagellomeres. Punctures on mesoscutum weaker than female. T I 1.14–1.26 × as long as maximum width. T II 0.83–0.93 × as long as maximum width.

Coloration **(Fig. 5E, F).** Body (excluding wings and legs) black. Clypeus, palpi, face, ventral surface of antenna, malar space, propleuron, epicnemium, mesosternum, tegula, subtegular ridge and mesepisternum whitish-yellow. Gena tinged with whitish-yellow ventrally. Mandible whitish-yellow, except for apex. Lateral aspect of pronotum tinged with whitish-yellow ventrally and posteriorly. Mesopleuron with a large whitish-yellow marking, it enlarged anteriorly. Scutellum with a whitish-yellow spot apically. T III with a pair of whitish-yellow spots anteriorly (sometimes these spots united into a single spot). T IV and T V each with a transverse whitish-yellow band anteriorly. Wings hyaline. Veins and pterostigma brown to blackish-brown except for yellow wing base. Legs yellow to yellowish-brown. Hind coxa and trochanter each with a dorsal blackish-brown stripe. Hind trochantellus and tibia tinged with blackish-brown.

Distribution. Japan (Hokkaido and Honshu). Outside Japan, this species is widely distributed in the Holarctic and Oriental regions (Yu et al. 2016).

Bionomics. Host unknown. Most adults were collected from the treetops of broad-leaved trees.

Remarks. This is the first record of this species from Hokkaido.

Woldstedtius punctatus sp. nov.

http://zoobank.org/4934EAC1-4504-45A8-9848-B1F7BF26301B

Figs 6A–F, 9J

Type series. ***Holotype*****:** F, Japan, Honshu, Kanagawa Pref., Nakai Town, Zoushiki, 16 Apr 2019, K. Watanabe leg. (KPMNH). ***Paratypes*****:** Japan: [Honshu] 1 M, Niigata Pref., Nagaoka City, Joganji Town, Mt. Happoudai, 24 May 2014, S. Shimizu leg. (KPMNH); 1 M, Saitama Pref., Urawa City, Tajima, 21 Apr 1999, T. Nambu leg. (KPMNH); 1 F, Kanagawa Pref., Kamakura City, Nikaidou, Zuisenji, 24 Apr 1955, H. Nagase leg. (KPMNH); 1 M, Kanagawa Pref., Oiso Town, Koma, Komayama, 16 Apr 2016, K. Watanabe leg. (KPMNH); 1 F, Kanagawa Pref., Mt. Hinokiboramaru, 16 May 2013, (FIT) (KPMNH); 1 M, Kanagawa Pref., Mt. Komotsurushiyama, 16 Jun 2013, (FIT) (KPMNH); 1 F, Kanagawa Pref., Yamakita Town, Nakagawa, Mt. Hinokiboramaru, 16 Jun 2015, K. Watanabe leg. (KPMNH); 1 F, Nagano Pref., Otaki Vil., Ontakekyuukamura, 8 Jul 2011, M. Ito leg. (LT) (TMNH); 5 M, Fukui Pref., Ikeda Town, Mizuumi, Mt. Hekosan, 18 Jun 2016, S. Shimizu leg. (KPMNH); 2 M, ditto, 18 Jun 2016, T. Tokuhira leg. (TMNH); 1 F, Osaka Pref., Higashiosaka City, Hiraoka-park, 19 Apr 2020, Y. Yamamoto leg. (KPMNH).

Description. Female (n = 6). Body length 7.5–10.7 (HT: 7.5) mm, polished, coriaceous, covered with silver setae.

Head 0.5–0.53 (HT: 0.5) × as long as wide. Clypeus 1.9–2.0 (HT: 1.92) × as broad as high, slightly convex basally in lateral view. Face 2.3–2.5 (HT: 2.4) × as broad as high, densely punctate, convex medially in lateral view and separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 6B). Length of malar space 1.0–1.2 (HT: 1.1) × as long as basal mandibular width. POL 2.1–2.3 (HT: 2.1) × as long as OD. OOL 0.88–1.0 (HT: 1.0) × as long as OD. POL 2.1–2.5 (HT: 2.3) × as long as OOL. Antenna with 23–25 (HT: 24) flagellomeres. FL I 1.3–1.4 (HT: 1.3) × as long as FL II. MP IV 1.25–1.5 (HT: 1.25) × as long as MP V.

Mesosoma. Lateral aspect of pronotum strigose anteriorly. Mesoscutum finely and densely punctate (separated by ca. 1.0 × their diameter) (Fig. 6C). Scutellum coarse-

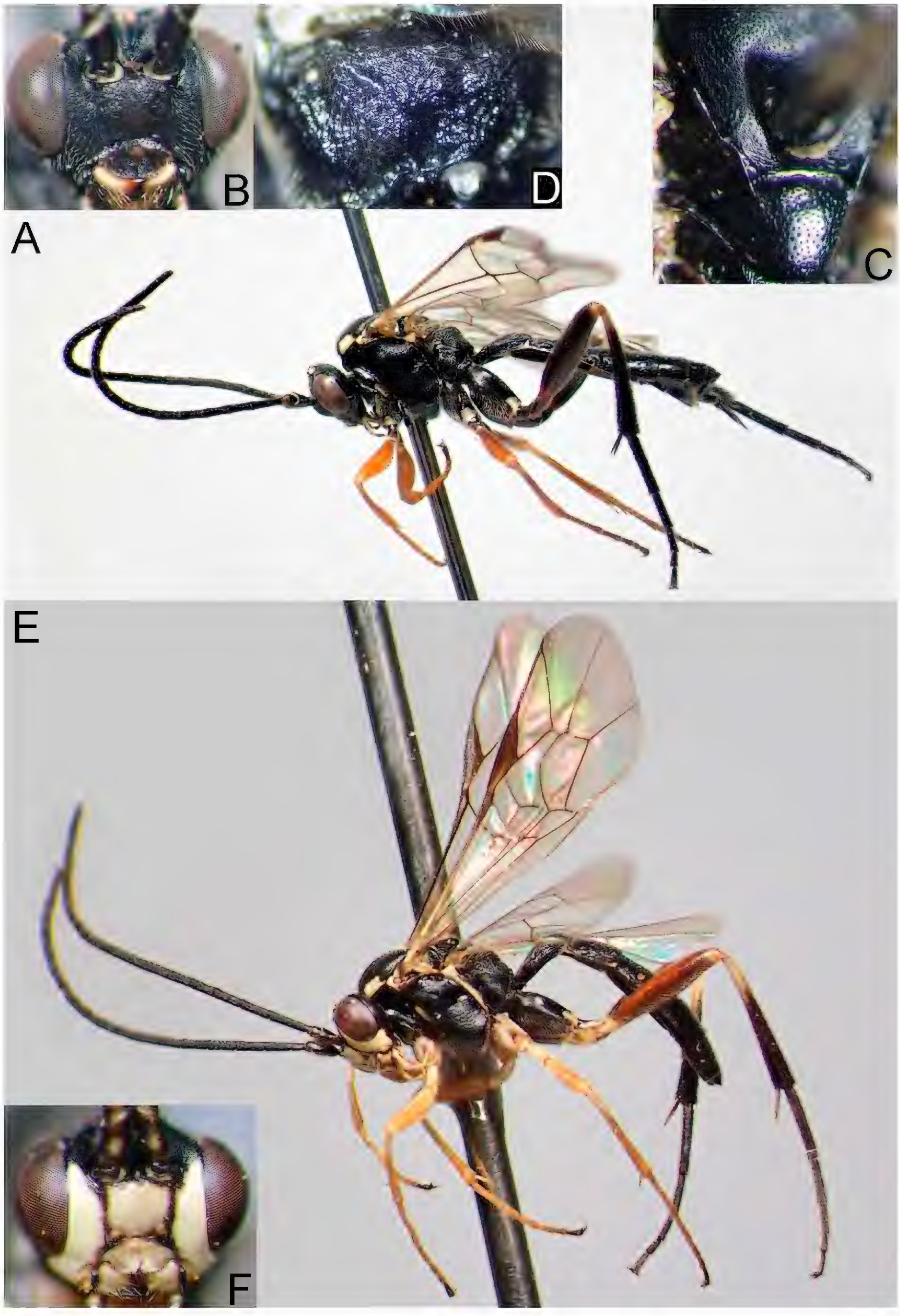

Figure 6. *Woldstedtius punctatus* sp. nov. (**A–D.** female, holotype; **E, F.** male, paratype) — **A, E.** Habitus; **B, F.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

ly and densely punctate (separated by ca. 0.8–1.3 × their diameter) (Fig. 6C). Mesopleuron coarsely and sparsely punctate except for speculum. Sternaulus weakly impressed. Propodeum rounded in lateral view, rugulose (Fig. 6D), without carinae except for pleural carina. Fore wing length 6.9–8.9 (HT: 7.0) mm. Nervellus intercepted below middle. Hind femur 4.25–4.5 (HT: 4.25) × as long as maximum depth in lateral view. Hind tibia 7.1–7.7 (HT: 7.1) × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6: 0.4: 0.25: 0.3.

Metasoma. T I rectangular in dorsal view (Fig. 9J), 1.2–1.26 (HT: 1.25) × as long as maximum width, rugulose laterally. Latero-median carina present basal ca. 0.5 of T I (Fig. 9J). T II 0.6–0.75 (HT: 0.6) × as long as maximum width, strigose anteriorly and laterally.

***Coloration* (Fig. 6A–D).** Body (excluding wings and legs) black. Sometimes face with a small brown spot medially. Palpi and upper mesepisternum yellow. Mandible yellowish-brown except for apex and base. Lateral aspect of pronotum with a yellow spot posteriorly. Mesoscutum with small yellow shoulder marks. Tegula tinged with yellow anteriorly. Wings hyaline. Veins and pterostigma blackish-brown except for yellowish-brown wing base. Legs black. Apex of fore and mid trochanters, base of fore trochantellus and base of hind tibia tinged with white. Fore and mid femora, tibiae and tarsi orange. Apex of hind trochantellus and base of hind femur tinged with reddish-brown.

Male (n = 11). Similar to female. Body length (excluding antennae) 5.5–9.8 mm. Length of malar space 0.9–1.1 × as long as basal mandibular width. Inner orbits weakly divergent downward (Fig. 6F). Fore wing length 5.0–8.0 mm.

***Coloration* (Fig. 6E, F).** Body (excluding wings and legs) black. Face with a large whitish-yellow spot medially and whitish-yellow longitudinal stripes along inner orbits. Clypeus, palpi, malar space, ventral surface of antenna and mesepisternum whitish-yellow. Mandible whitish-yellow except for apex. Lateral aspect of pronotum with a whitish-yellow spot posteriorly. Mesoscutum with whitish-yellow shoulder marks. Tegula tinged with whitish-yellow anteriorly. Subtegular ridge brown. Epicnemium with a small whitish-yellow spot. Wings hyaline. Veins and pterostigma brown to blackish-brown except for yellowish-brown wing base. Legs whitish-yellow to yellow. Fore and mid coxae tinged with black basally. Hind coxa, tibia and tarsomeres black. Hind trochanter, trochantellus, apex of hind femur and base of hind tibia tinged with white. Hind femur brown.

Distribution. Japan (Honshu).

Bionomics. Host unknown. Most adults were collected in broad-leaved forests of mountainous regions. One paratype collected from the Nagano Prefecture was collected by light trap.

Etymology. The species name refers to the scutellum having coarse punctures.

Remarks. This species can be easily distinguished from any other species by the entirely black scutellum and the coarse and dense punctures on scutellum (separated by ca. 0.8–1.3 × their diameter).

Woldstedtius takagii (Uchida, 1957)

Figs 7A–D, 9C, D, K

Homocidus yokohamensis var. *takagii* Uchida, 1957: 251

Materials examined. ***Type series*:** JAPAN: [Hokkaido] 1 F (***holotype***), Hokkaido, Sapporo, 15 Jul 1955, S. Takagi leg. (SEHU). ***Non-types*:** JAPAN: [Honshu] 1 F, Yamanashi Pref., Koshu City, Mt. Daibosatsu, Kaminikkawa-toge, 16 Jun 2007, K. Watanabe leg. (KPMNH); 1 F, Toyama Pref., Nanto City, Togamura, Kamimomose, 25 Aug–1 Sep 2009, M. Watanabe leg. (MT) (KPMNH).

Description. Female (n = 3). Body length 7.7–7.9 mm, polished, coriaceous, covered with silver setae.

Head 0.47–0.52 × as long as wide. Clypeus 1.78–2.0 × as broad as high, convex basally in lateral view. Face 2.6–2.9 × as broad as high, densely punctate, convex medially in lateral view, separated from clypeus by shallow clypeal sulcus. Inner orbits strongly divergent downward (Figs 7B, 9C). Length of malar space 1.0–1.1 × as long as basal mandibular width. POL 2.0–2.15 × as long as OD. OOL 1.05–1.25 × as long as OD. POL 1.8–1.9 × as long as OOL. Antenna with 25–26 flagellomeres. FL I 1.2–1.33 × as long as FL II. MP IV 1.25–1.4 × as long as MP V.

Mesosoma. Lateral aspect of pronotum strigose anteriorly. Mesoscutum finely and densely punctate (separated by ca. 0.8–1.0 × their diameter) (Fig. 7C). Scutellum finely and densely punctate (separated by ca. 0.8–1.0 × their diameter) (Fig. 7C). Mesopleuron coarsely and densely punctate except for the areas on and below speculum. Sternaulus weakly impressed. Propodeum weakly protruded basal 0.2 in lateral view (Fig. 9D), rugulose (Fig. 7D), without carinae except for pleural carina. Fore wing length 6.5–7.4 mm. Nervellus intercepted below middle. Hind femur 4.2–4.3 × as long as maximum depth in lateral view. Hind tibia 7.5 × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.6–0.7: 0.4: 0.2–0.3: 0.3.

Metasoma. T I nearly square in dorsal view (Fig.9K), 0.95–1.05 × as long as maximum width, rugulose laterally. Latero-median carina present basal ca. 0.5 of T I (Fig.9K). T II 0.65–0.75 × as long as maximum width, striate anteriorly.

***Coloration* (Fig. 7A–D).** Body (excluding wings and legs) black. Face with a large yellow spot medially (this spot sometimes obscured). Palpi, tegula and mesepisternum yellow (mesepisternum sometimes darkened ventrally). Mandible yellow except for apex and base. Lateral aspect of pronotum with a yellow spot posteriorly. Scutellum with a yellow spot apically. Subtegular ridge often tinged with yellow. Wings hyaline. Veins and pterostigma blackish-brown except for yellowish-brown wing base. Legs yellow to

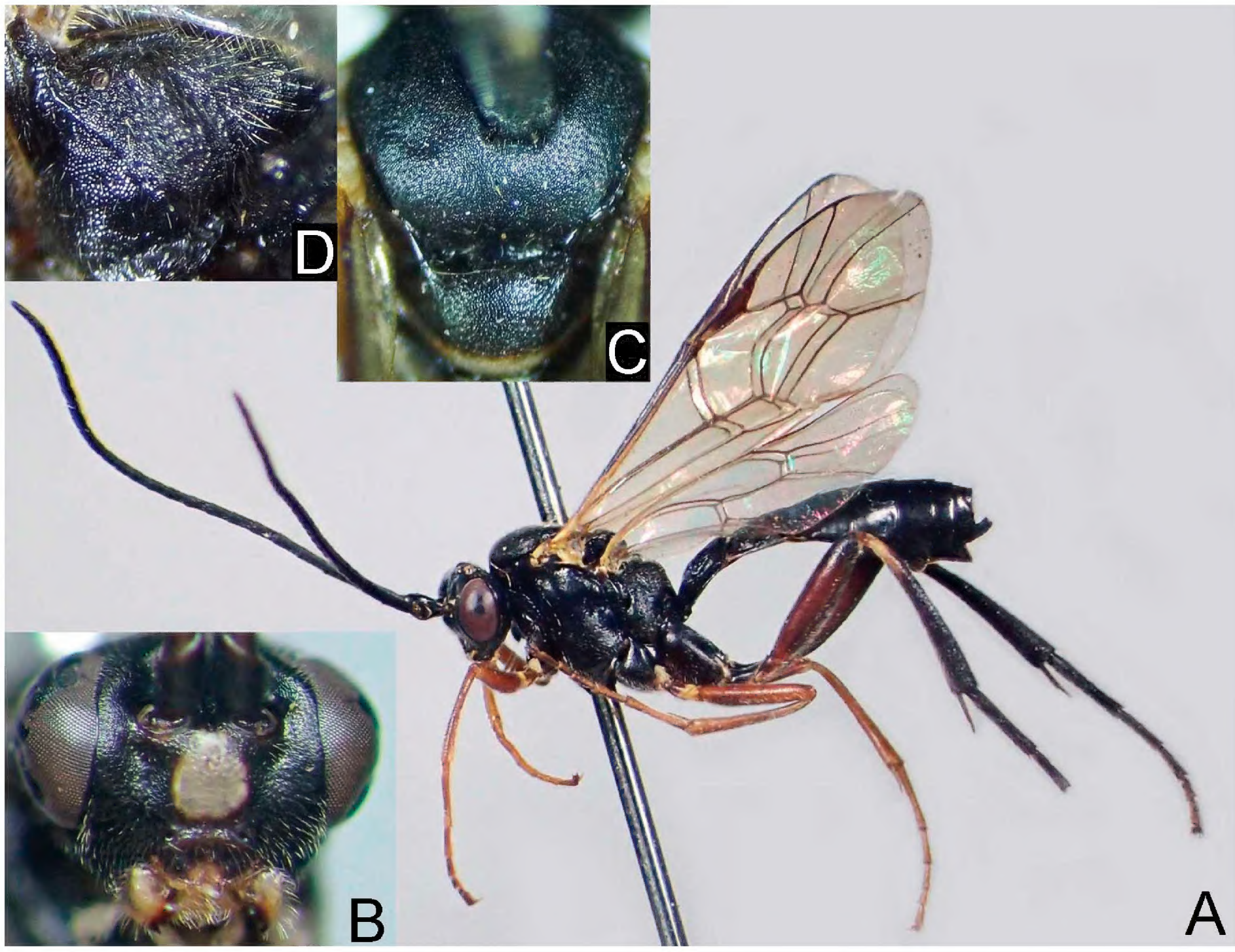

Figure 7. *Woldstedtius takagii* (Uchida, 1957) (**A–D.** female) — **A.** Habitus; **B.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

brown. Fore and mid trochanters often tinged with black. Coxae, hind trochanter, hind tibia and hind tarsomeres black. Hind trochantellus and femur reddish-brown to blackish-brown. Base of hind tibia tinged with white.

Male. Unknown.

Distribution. Japan (Hokkaido and Honshu).

Bionomics. Host unknown. Adults were collected in broad-leaved forests of mountainous regions.

Remarks. This species resembles *W. kuroashii*, but can be distinguished from the latter by the following combination of character states in females: inner orbits divergent downward (almost parallel in *W. kuroashii*); propodeum weakly protruded basal 0.2 in lateral view (rounded in *W. kuroashii*); yellow shoulder marks of mesoscutum absent (present in *W. kuroashii*).

Woldstedtius yokohamensis (Uchida, 1930)

Fig. 8A–D

Homocidus yokohamensis Uchida, 1930: 258

Materials examined. ***Type series*:** JAPAN: [Honshu] 1 F (***holotype***), Yokohama, 26 Apr 1928, K. Sato leg. (SEHU).

Description. Female (n = 1: *holotype*). Body length 9.1 mm, polished, coriaceous, covered with silver setae.

Head 0.5 × as long as wide. Clypeus 2.0 × as broad as high, convex basally in lateral view. Face 2.0 × as broad as high, finely and densely punctate, convex medially in lateral view, separated from clypeus by shallow clypeal sulcus. Inner orbits almost parallel (Fig. 8B). Length of malar space 1.1 × as long as basal mandibular width. POL 2.1 × as long as OD. OOL 1.25 × as long as OD. POL 2.0 × as long as OOL. Antenna with 26 flagellomeres. FL I 1.35 × as long as FL II. MP IV 1.33 × as long as MP V.

Mesosoma. Lateral aspect of pronotum strigose anteriorly. Mesoscutum finely and densely punctate (separated by ca. 1.0 × their diameter) (Fig. 8C). Scutellum finely and densely punctate (separated by ca. 1.0 × their diameter). Mesopleuron finely rugulose and densely punctate except for the areas on and below speculum. Sternaulus very weakly impressed. Propodeum rounded in lateral view, rugulose (Fig. 8D), without carinae except for pleural carina. Fore wing length 7.1 mm. Nervellus intercepted below middle. Hind femur 4.4 × as long as maximum depth in lateral view. Hind tibia 8.5 × as long as maximum depth in lateral view. Ratio of length of hind first to fifth tarsomeres 1.0: 0.7: 0.4: 0.2: 0.26.

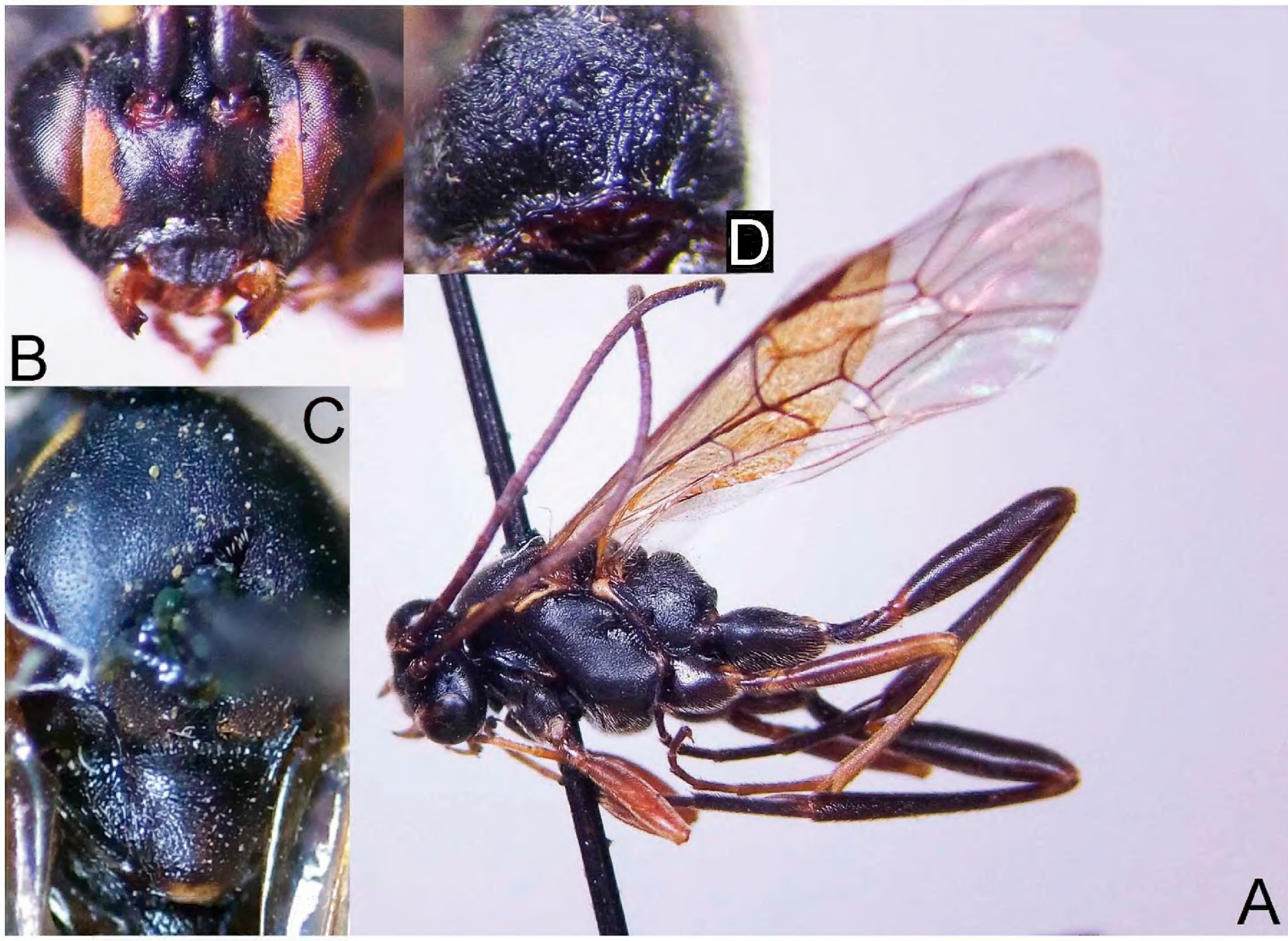

Figure 8. *Woldstedtius yokohamensis* (Uchida, 1930) (**A–D.** female, holotype) — **A.** Habitus; **B.** Head, frontal view; **C.** Mesonotum, dorsal view; **D.** Propodeum, dorsal view.

Metasoma. T I rectangular in dorsal view, 1.3 × as long as maximum width. Latero-median carina present basal ca. 0.5 of T I. T II 0.72 × as long as maximum width, striate anteriorly and strigose laterally.

***Coloration* (Fig. 8A–D).** Body (excluding wings and legs) black. Face with a pair of yellow spots along inner orbits. Palpi, subtegular ridge and upper mesepisternum yellow. Mandible yellow except for apex. Lateral aspect of pronotum with a yellow spot posteriorly. Mesoscutum with yellow shoulder marks. Scutellum with a yellow spot apically. Wings hyaline. Veins and pterostigma blackish-brown except for yellowish-brown wing base. Legs black. Fore and mid trochantelli, femora, tibiae and tarsi yellowish-brown to brown. Apex of hind trochantellus and base of hind femur tinged with reddish-brown. Base of hind tibia tinged with brown.

Male. Unknown.

Distribution. Japan (Honshu). Outside Japan, this species has been recorded from South Korea (Balueva and Lee 2016).

Bionomics. Unknown.

Remarks. This species may be rare in Japan. We could only examine the holotype. No additional specimen of this species from Japan was found.

Notes on the distribution and habitat of Japanese *Woldstedtius*

In the Japanese Diplazontinae, the proportion of the species with holarctic distribution shows a strong bias by genus (e.g., 44% in *Diplazon*, 14% in *Promethes* and 17% in *Sussaba*). Our findings revealed that 33% (three of nine species) of Japanese *Woldstedtius* are also distributed in the Holarctic region. In addition, given that *W. karafutensis* and *W. yokohamensis*, which were previously known only from Japan, have subsequently been recorded in Korea by Balueva and Lee (2016), we speculate that the currently known Japanese endemics, namely, *W. alpicola*, *W. punctatus*, and *W. takagii*, may also be distributed in other parts of the Eastern Palearctic Region.

Woldstedtius biguttatus is the most commonly collected species of *Woldstedtius* in Japan, and is typically found in different types of open habitat (e.g., grasslands, meadows, and paddy fields). In contrast, those species characterized by black coxae, namely, *W. alpicola*, *W. kuroashii*, *W. punctatus*, and *W. takagii*, are generally collected from the canopies of broad-leaved trees, and compared with *W. biguttatus*, fewer specimens of these species have been collected. We specu-

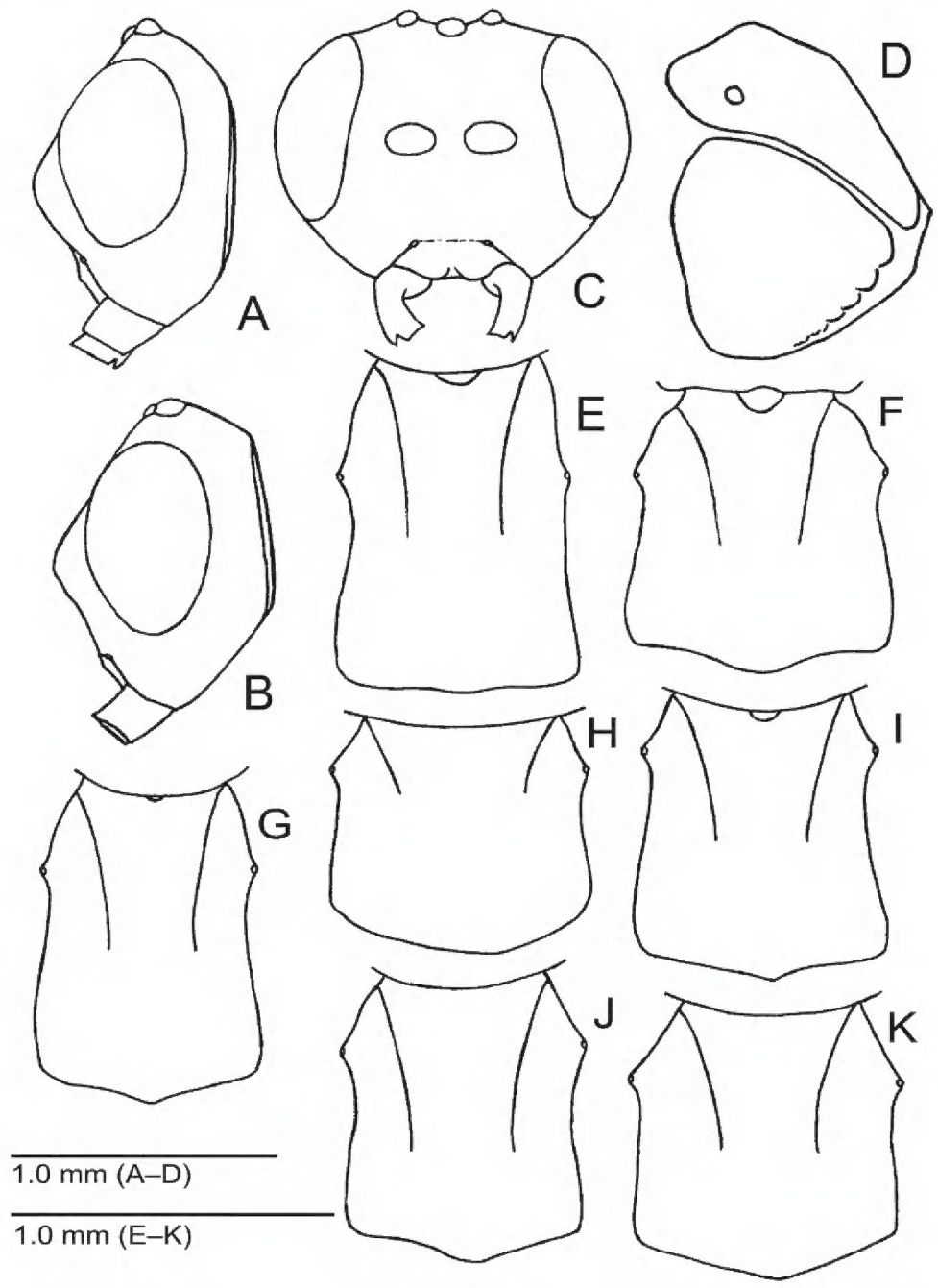

Figure 9. Japanese *Woldstedtius* **A, G.** *W. f. flavolineatus* (Gravenhorst, 1829); **B, I.** *W. kuroashii* (Uchida, 1957); **C, D, K.** *W. takagii* (Uchida, 1957); **E.** *W. alpicola* sp. nov.; **F.** *W. biguttatus* (Gravenhorst, 1829); **H.** *W. karafutensis* (Uchida, 1957); **J.** *W. punctatus* sp. nov. (**E, J.** holotype; **B, I.** paratype) — **A, B.** head, lateral view; **C.** head, frontal view; **D.** propodeum, lateral view; **E–K.** T I, dorsal view.

late that these differences in habitat usage could be attributable to the habitat requirements of the respective host species.

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